DERWENT-ACC-NO: 1987-206910
DERWENT-WEEK: 198730

TITLE: Engine compartment silencing - by lining with four layers of specified material

INVENTOR: STOBER, H

PATENT-ASSIGNEE: DAIMLER-BENZ AG[DAIM]

PRIORITY-DATA: 1986DE-3601204 (January 17, 1986)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
DE 3601204 A	July 23, 1987	N/A	004	N/A
DE 3682265 G	December 5, 1991	N/A	000	N/A
EP 229977 A	July 29, 1987	G	000	N/A
EP 229977 B	October 30, 1991	N/A	000	N/A

DESIGNATED-STATES: DE FR IT SE DE FR IT SE

CITED-DOCUMENTS: A3...8904; DE 2006741 ; DE 2818252 ; DE 2909802 ; No-SR.Pub ; US 2028950 ; US 2959495

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
DE 3601204A	N/A	1986DE-3601204	January 17, 1986
EP 229977A	N/A	1986EP-0117180	December 10, 1986

INT-CL_(IPC): B60R013/08; D21J001/20 ; G10K011/16

ABSTRACTED-PUB-NO: DE 3601204A
BASIC-ABSTRACT: A noise absorbing lining for the engine space of a motor

vehicle consists of four layers. The first layer is made of aramide fibre mat
with a unit weight of 130 g/sq.m., the second layer is rock wool or basalt wool
(1500g/bq.m), the third layer is a textile material, pref. rayon or carded wool
(800 g/sq.m.) and the fourth layer is made of a polyester fibre mat
(150g/sq.m). The side toward the engine is best lined with aluminium foil.

USE/ADVANTAGE - This lining combines good sound absorption with a long service
life.

ABSTRACTED-PUB-NO: EP 229977B
EQUIVALENT-ABSTRACTS: A sound-damping lining of the engine space of motor
vehicles consisting in a multilayer formed element of fibre material which has
been shaped by the application of pressure and heat to constitute the formed
element with the creation of areas of defined presettable compression,
characterised in a first layer (1) facing the engine in a thermally highly
loadable plastic fibre material, with a surface weight of 50 to 300 g/m2, a
second layer (2) in an inorganic thermally highly loadable fibre material, with
a surface weight of 500 to 5000 g/m2 and a third layer in a textile fibre
material with a surface weight of 300 to 3000 g/m2. (5pp)

CHOSEN-DRAWING: Dwg.0/1

TITLE-TERMS:
ENGINE COMPARTMENT SILENCER LINING FOUR LAYER SPECIFIED MATERIAL

DERWENT-CLASS: A32 A95 P86 Q17

CPI-CODES: A05-E01B3; A05-F05; A12-S05G; A12-T04B; A12-T04C;

POLYMER-MULTIPUNCH-CODES-AND-KEY-SERIALS:
Key Serials: 0016 0231 1283 1291 1982 1986 2524 2528 2624

2646 3258 2723 2728
2820 2821 3300 2829 2844
Multipunch Codes: 014 04- 141 143 144 151 252 253 256 42&
440 47& 477 481 483
50& 551 560 562 57& 575 581 617 651 664 665 667 672 699
SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1987-086658
Non-CPI Secondary Accession Numbers: N1987-154851

DERWENT-ACC-NO: 1989-364792
DERWENT-WEEK: 198950

TITLE: Noise insulating lining for engine compartment of motor vehicles - is made of 1st layer of inorganic fibre material and 2nd layer of carbon fibres

INVENTOR: TUERK, H G; TUERK, H

PATENT-ASSIGNEE: DEUT BASALTSTEINWOLLE GMBH[DEBAN]

PRIORITY-DATA: 1988DE-3818301 (May 30, 1988) , 1989EP-0121743 (November 24, 1989)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
DE 3818301 A	December 7, 1989	N/A	005	N/A
DE 3818301 C	November 22, 1990	N/A	000	N/A
EP 428786 A	May 29, 1991	N/A	000	N/A
EP 428786 B1	February 1, 1995	G	007	B32B 019/06
ES 2068875 T3	May 1, 1995	N/A	000	B32B 019/06

DESIGNATED-STATES: ES FR GB IT SE ES FR GB IT SE

CITED-DOCUMENTS: DE 3734239; EP 162645 ; EP 229977 ; EP 58489

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
DE 3818301A	N/A	1988DE-3818301	May 30, 1988
EP 428786A	N/A	1989EP-0121743	November 24, 1989
EP 428786B1	N/A	1989EP-0121743	November 24, 1989

ES 2068875T3 N/A 1989EP-0121743
November 24, 1989
ES 2068875T3 Based on EP 428786
N/A

INT-CL_(IPC): B32B019/06; B60R013/08

ABSTRACTED-PUB-NO: DE 3818301A
BASIC-ABSTRACT: A noise insulating lining for the engine compartment of motor vehicles is made of two layers. A first layer is made of inorganic fibre material such as rock wool, ceramic, quartz and glass fibres which have been solidified by a heat resisting binder. A second layer is made of carbon fibres and produced as a needleloom mat from staple or cut fibres. The two layers are bonded by an adhesive based on melamine.

ADVANTAGE - This combines good sound insulation with thermal insulation for temperatures up to 500 deg.C.

ABSTRACTED-PUB-NO: DE 3818301C
EQUIVALENT-ABSTRACTS: A noise insulating lining for the engine compartment of motor vehicles is made of two layers. A first layer is made of inorganic fibre material such as rock wool, ceramic, quartz and glass fibres which have been solidified by a heat resisting binder. A second layer is made of carbon fibres and produced as a needle loom mat from staple or cut fibres. The two layers are bonded by an adhesive based on melamine.

ADVANTAGE - This combines good sound insulation with thermal insulation for temperatures up to 500 deg.C.

EP 428786B

A sound reducing liner for the engine bay of motor vehicle, the liner consisting of a shaped body having a plurality of layers which are joined to each other under the influence of heat and pressure with

the addition of a
binding compound, where one of the layers consists of an inorganic, thermally
loadable fiber material which is bound by a binder, characterized in that the
layer (3) facing the motor is made of a thermally loadable carbon fiber
material which is not bound by a binder, and where binding compound (4)
contains melamine resin.

CHOSEN-DRAWING: Dwg.0/3 Dwg.0/3 Dwg.1/3

TITLE-TERMS:
NOISE INSULATE LINING ENGINE COMPARTMENT MOTOR VEHICLE MADE LAYER INORGANIC
FIBRE MATERIAL LAYER CARBON FIBRE

DERWENT-CLASS: A95 P73 Q17

CPI-CODES: A05-B02; A12-T04B; A12-T04C;

POLYMER-MULTIPUNCH-CODES-AND-KEY-SERIALS:
Key Serials: 0016 0020 0213 0231 0367 0368 1276 1283 1285 1309 1737 2524 2528
3249 3251 3258 2682 2723 2724 2820 3300 2829 2844
Multipunch Codes: 014 034 04- 05- 072 074 139 141 151 153 185 189 27- 331 42&
440 441 477 481 483 50& 51& 53& 532 533 534 535 546 57& 609 617 651 664 665 672
684 688
SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1989-161732
Non-CPI Secondary Accession Numbers: N1989-277463

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(43) Date of A publication 06.10.1993

(21) Application No 9306047.3

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(30) Priority data
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(51) INT CL[5]
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(52) UK CL (Edition L)
B5N N0104 N0110 N0514 N0526 N0528 N0900 N1704 N175 N176 N178 N179 N18X N181 N195 N196 N207 N21X N21Y N211 N223 N224 N225 N226 N231 N232 N237 N238 N255 N256 N259 N26Y N261 N2702 N2704 N2720 N2732 N2736 N2742 N37X N372 N401 N408 N410 N411 N418 N419 N42X N46X N466 N489 N494 N500 N501 N502 N53X N53Y N53U N531 N55/ N56Y N562 N589 N59X N618 N648 N649 N658 N66Y N661 N662 N670 N671 N672 N681 N683 N70X N705 N707 N726 N728 N729 N77X
F2X X7D3 X7D4 X7G2 X7X7
U1S S1405 S1417 S1820 S1824 S1946 S1990

(56) Documents cited
None

(58) Field of search
UK CL (Edition L) B5N, F2X
INT CL[5] B32B, B60R, F02B
Online database: WPI

(54) **A cowling for internal-combustion engines of motor vehicles**

(57) A self-supporting, heat and sound insulating cowling for internal-combustion engines of motor vehicles comprises a plurality of layers which have been compression-moulded under the effect of pressure and heat to form zones of defined-predetermined compaction. The cowling comprises, on the engine side, a thicker, heat insulating and sound insulating layer (2) of an inorganic fibrous material, which is covered by a layer (4) of carbon-fibre material. A thicker layer (3) of inorganic fibrous material, facing away from the engine, cures to form a self-supporting support layer. 25 to 35% by volume of it consists of 25 to 50 mm long glass fibres and the rest consists of either a high temperature resistant polyester resin and mineral filler or polypropylene. This support layer may be covered on the bodywork side by a layer (5) of non-woven polyester or polyacrylonitrile fibres.

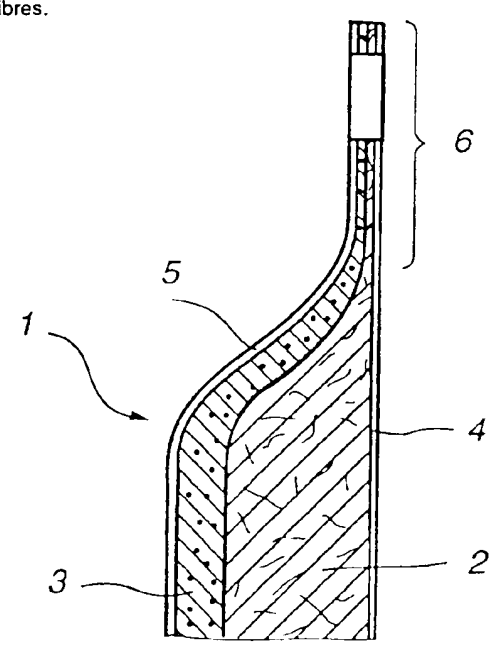

Fig. 1

GB 2 265 569 A

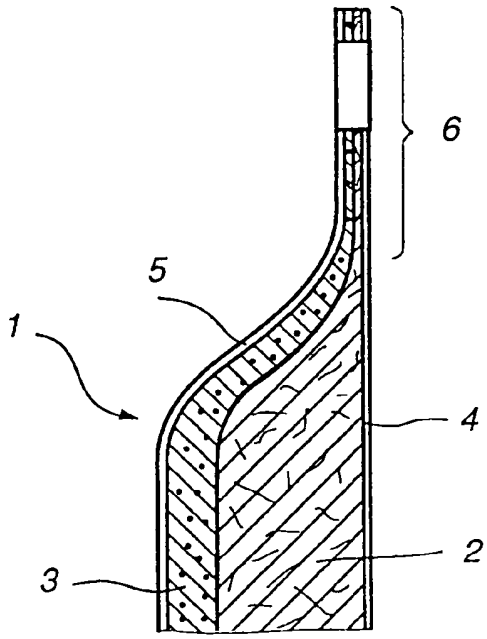

Fig. 1

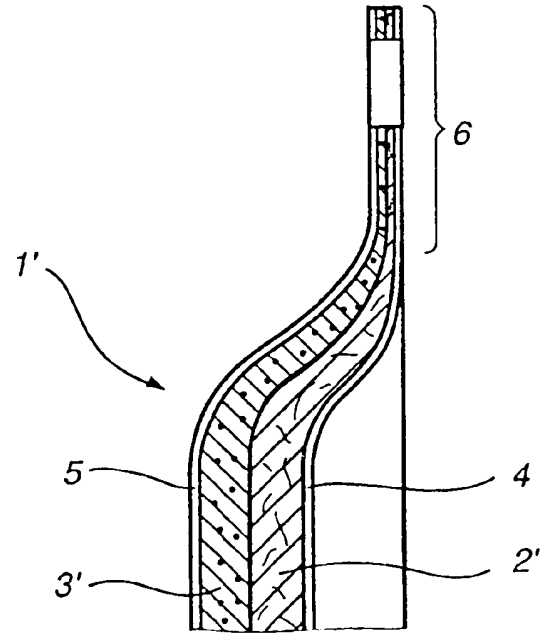

Fig. 2

A cowling for internal-combustion engines of motor vehicles

The invention relates to a self-supporting, heat and sound insulating cowling for internal-combustion engines of motor vehicles, as is known from commercial vehicles mass-produced by the applicant.

In the known construction, the cowling is fitted on both sides of the engine, mounted underneath the driver's cab, in the region between the frame side member and the underside of the driver's cab.

German Offenlegungsschrift 3,601,204 discloses an absorption moulding which comprises a plurality of nonwoven layers and may serve for such sound insulating cowlings for the engine compartment of motor vehicles, but which is not dimensionally stable. The already known absorption moulding comprises a top layer, on the engine side, of synthetic fibres, an adjoining heat insulating and sound absorbing layer of inorganic fibrous material which can be subjected to high thermal loads, and a further absorbing layer of organic fibres. This moulding is unsuitable in cases where there is high thermal loading, since both the synthetic fibrous material of the top layer and the organic fibres are in the long term damaged or destroyed by the high temperatures in the engine compartment. As mentioned, the absorption moulding itself is also not dimensionally stable and has to be installed together with a dimensionally adapted support shell, to be produced separately. Thus, a cowling produced in this way obtains the self-supporting characteristic mentioned at the beginning only by having the separate support shell, as a result of which the effort involved in producing the cowling itself, as well as the effort involved in installation, that is, ultimately the costs for the ready-fitted cowling, are relatively high.

In German Patent Specification 3,818,301 there is likewise described a noise insulating moulding for the engine compartment of motor vehicles in which inorganic

fibrous material, which can be subjected to high thermal loads and is bonded by a binder, is covered on the engine side by a carbon-fibre material by means of a joining medium containing melamine resin. This moulding is intended to have good noise insulation and also is suitable for use as a thermal insulation up to a temperature range of about 500°C. It is in this case also envisaged that the moulding is provided with a layer of carbon fibres towards the bodywork. This layer of carbon fibres is intended to provide certain mechanical protection for the sensitive layer of inorganic fibrous material. Altogether, the moulding described there also does not constitute a dimensionally stable cowling for the engine compartment of motor vehicles, but has to be paired with a dimensionally adapted support shell in order for it to be able to form a self-supporting cowling; thus, a self-supporting cowling formed by the pliant absorption moulding just described would also be relatively expensive.

The present invention seeks to develop a cowling in such a way that, while retaining the noise insulating and heat insulating effect and the self-supporting characteristic, the cowling is easier to produce and install.

According to the present invention there is provided a self-supporting, heat and sound insulating cowling for internal-combustion engines of motor vehicles, comprising an absorption moulding adapted to be on an engine side within the cowling and formed by a plurality of nonwoven layers, and a dimensionally adapted support shell, arranged on the side facing away from the engine within the cowling and stabilising the absorption moulding in its intended shape and installed position, the nonwoven layers of the absorption moulding being compressed to form zones of predetermined compaction and the absorption layer of the absorption moulding which serves for sound absorption and thermal shielding of the engine heat containing inorganic fibres, wherein the support shell is structurally integrated with the absorption moulding to form a single compression-

moulded part by there being moulded on the side facing away from the engine of the effectively absorbing nonwoven layers of the cowling a very substantially pore-free, about 1 to 5 mm thick support layer compressible together with the effectively absorbing nonwoven layers of the cowling to form a uniform moulding and of which

- 25 to 35% by volume consists of 25 to 50mm long glass fibres and otherwise either

a) contains 25 to 35% by volume of a high temperature resistant polyester resin and 35 to 45% by volume of mineral fillers or

b) contains 65 to 75% by volume of polypropylene.

Thanks to the special composition of the material for the base layer, the latter can be moulded together with the other effectively absorbing nonwoven layers in one and the same compression moulding operation to form a uniform dimensionally stable workpiece, that is to form a uniform self-supporting cowling, whereby not only the production of the cowling, but also its installation is made significantly easier and cheaper. Due to the different composition of the individual layers, a different characteristic of the layers is achieved in spite of the same pressures and temperatures for all the layers. The nonwoven layers remain adequately loose for the required absorption effect, whereas the support layer is pore-free, hard and rigid. Of the two alternatives for the support layer, the design according to alternative a) is intended for high temperature loading of the support layer up to, for example, about 500°C, whereas the design of the support layer according to alternative b) is intended for cases of lower temperature loading, for example up to about 200°C, and/or the requirement for good noise insulation.

Preferably, when the support layer contains 25 to 35% by volume of a high temperature resistant polyester resin and 35 to 45% by volume of mineral fillers, the mineral filler for the support layer contains quartz sand. The effectively absorbing nonwoven layer of the cowling may

contain about 85 to 96%, preferably 94%, by volume of basalt wool and otherwise phenolic resin binder. The effectively absorbing nonwoven layer of the cowling may be provided on the surface facing the engine compartment with a top layer consisting of a carbon-fibre material.

Preferably, the support layer contains 65 to 75% by volume of polypropylene, the effectively absorbing nonwoven layers of the cowling containing a nonwoven layer or consisting completely of a nonwoven layer of which about 70 to 80%, preferably 75%, by volume is composed of synthetic and/or textile fibres and the rest is composed of phenolic resin binder.

Preferably, the surface of the support layer is provided with a 0.5 to 2 mm thick covering layer of cotton fibres, polyester fibres or polyacrylonitrile fibres.

Two exemplary embodiments of the invention are described below by way of example and represented in a drawing, in which:

Fig. 1 shows a partial cross-section through a first embodiment of a one-part self-supporting cowling part and

Fig. 2 shows a partial cross-section through a second embodiment of a cowling part.

Figure 1 shows the self-supporting cowling 1 which can be subjected to relatively high thermal loads, comprising the absorption layer 2, compression-moulded from a nonwoven layer of inorganic fibres, and the support layer 3, consisting of glass fibres, mineral filler and binder, compression-moulded together with the absorption layer 2 and thereby compacted pore-free and cured. The heat-resistant absorption layer 2 consists to a great extent, for example 94% by volume, of mineral fibres, in particular basalt wool, which are mixed with a binder, for example with 6 % by volume of phenolic resin binder. Thanks to the relatively low binder content in the absorption layer, this layer - apart from the edge zones with extremely high pressure per unit area - continues to contain pores even after the joint

hot press moulding operation and, because of this, has a good heat insulating and sound insulating effect. In the support layer 3, on the other hand, the fibre content is considerably lower than in the absorption layer 2; to be precise, only a quarter to about a third of the support layer consists of inorganic fibres, in particular of glass fibres. The remaining, greater part of the constituents of the support layer is predominantly made up of inorganic filler and otherwise resin binder. In order to obtain in the hot press moulding of the cowling part a stable, cured support layer 3 which can be subjected to high thermal loads, a high temperature resistant polyester resin is used as binder. Quartz sand has proved to be particularly suitable as mineral filler for the support layer.

The absorption layer 2 facing the engine is provided with a top layer 4 of carbon fibres. This top layer on the engine side preferably has a thickness of 1 to 2 mm and a weight per unit area of 100 to 150 g/m^2. In the case of the exemplary embodiment represented, for visual reasons the support layer 3 is also provided on the outside with a top layer 5 having a layer thickness of about 1 mm and a weight per unit area of 100 to 150 g/m^2, which consists of a polyester nonwoven or of polyacrylonitrile fibres. This top layer may also be bonded to the surface of the support layer 3 by an interposed, heat-activatable adhesive film.

Reference 6 denotes the edge zones of the support layer 3, which have a particularly high density and consequently also a high mechanical stability; to be precise, on account of an appropriate shaping of the compression mould, the fibres of the absorption layer are compacted pore-free in this region as well. This is achieved on the one hand by an appropriate shaping of the compression mould and a correspondingly high compressing pressure in the edge zones. In addition, in the edge zone the binder content can also be increased specifically in this location by spraying on binder resin. The openings required for fitting the cowling in the motor vehicle, for example screw through-

holes, can be punched out in these edge zones.

The moulding is produced in one operation. First of all the material mixture for the support layer 3, made up in a prefabricated nonwoven, is laid in the lower half of an opened compression mould and the material for the absorption layer 2, likewise prepared in nonwoven form, is placed thereupon. A carbon-fibre nonwoven is also placed onto the absorption material. The compression mould filled in this way is then closed and pressed together under the effect of heat, the cowling receiving its shape and the material of the support layer being compacted pore-free and compressed to form a cured, self-supporting layer having a thickness of 1 to 5 mm. After the compressing operation, the thickness of the support layer in the centre of the moulding is normally 3 to 5 mm and decreases towards the edge layers down to about 1 mm. Depending on the configuration of the cowling, during the compressing operation this material layer is compressed to a layer of about 50 mm thickness in the centre of the moulding and to about 5 mm in the edge zones, with a weight per unit area of 1500 to 3000 kg/m^2. Since the support layer 3 and the absorption layer 2 contain binder dispersed within their fibres, this results in a good cohesion of the various layers in the hot press moulding of the cowling.

The cowling 1', of which a portion is represented cross-sectionally in Figure 2, is intended in particular for a thermal loading up to at most 200 to 220°C; it differs from the exemplary embodiment according to Figure 1, which can be subjected to high thermal loads, in particular by the composition of the absorption layer 2' and of the support layer 3'. To be precise, here the support layer is designed virtually as a fibre-reinforced polypropylene moulding which is integrated in the cowling and of which about a quarter consists of inorganic fibres of about 25 to 50 mm in length, for example of glass fibres or of basalt fibres, and the rest of polypropylene. About three quarters of the absorption layer 2' is formed by synthetic and/or textile

fibres and the rest by phenolic resin as binder. The two top layers 4 and 5 are designed the same as in the example according to Figure 1. It is quite conceivable for both alternative configurations of the absorption layer to be provided in one and the same cowling, to be precise at points of higher thermal loading, well in excess of 200°C; for example, in the vicinity of the exhaust pipe, a nonwoven of inorganic fibres is placed on, and in the remaining regions, less subjected to thermal loading, a nonwoven of synthetic or textile fibres is placed on.

The advantages which can be achieved by the self-supporting, one-part cowling according to the invention are, in particular, the inexpensive producibility and installation of the cowling, a good sound absorbing effect and - in the case of the configuration which can be subjected to higher thermal loads according to Figure 1 - the extremely high thermal loadability. The cowling can be fitted in all motor vehicles, both in passenger cars and in trucks, not only in the engine compartment of the vehicle but, if appropriately cut to size, anywhere where there are heat sources in a vehicle which have to be shielded off, for example exhaust pipes and turbo chargers etc.

Claims

1. A self-supporting, heat and sound insulating cowling for internal-combustion engines of motor vehicles, comprising an absorption moulding adapted to be on an engine side within the cowling and formed by a plurality of nonwoven layers, and a dimensionally adapted support shell, arranged on the side facing away from the engine within the cowling and stabilising the absorption moulding in its intended shape and installed position, the nonwoven layers of the absorption moulding being compressed to form zones of predetermined compaction and the absorption layer of the absorption moulding which serves for sound absorption and thermal shielding of the engine heat containing inorganic fibres, wherein the support shell is structurally integrated with the absorption moulding to form a single compression-moulded part by there being moulded on the side facing away from the engine of the effectively absorbing nonwoven layers of the cowling a very substantially pore-free, about 1 to 5 mm thick support layer compressible together with the effectively absorbing nonwoven layers of the cowling to form a uniform moulding and of which

- 25 to 35% by volume consists of 25 to 50mm long glass fibres and otherwise either

a) contains 25 to 35% by volume of a high temperature resistant polyester resin and 35 to 45% by volume of mineral fillers or

b) contains 65 to 75% by volume of polypropylene.

2. A cowling according to Claim 1, wherein, when the support layer contains 25 to 35% by volume of a high temperature resistant polyester resin and 35 to 45% by volume of mineral fillers, the mineral filler for the support layer contains quartz sand.

3. A cowling according to Claim 1, wherein, when the support layer contains 25 to 35% by volume of a high

temperature resistant polyester resin and 35 to 45% by volume of mineral fillers, the effectively absorbing nonwoven layer of the cowling contains about 85 to 96% by volume of basalt wool and otherwise phenolic resin binder.

4. A cowling according to claim 3, wherein the effectively absorbing nonwoven layer of the cowling contains about 94% by volume of basalt wool and otherwise phenolic resin binder.

5. A cowling according to Claim 1, wherein when the support layer contains 25 to 35% by volume of a high temperature resistant polyester resin and 35 to 45% by volume of mineral fillers, the effectively absorbing nonwoven layer of the cowling is provided on the surface facing the engine compartment with a top layer consisting of a carbon-fibre material.

6. A cowling according to Claim 1, wherein when the support layer contains 65 to 75% by volume of polypropylene, the effectively absorbing nonwoven layers of the cowling contain a nonwoven layer or consist completely of a nonwoven layer of which about 70 to 80% by volume is composed of synthetic and/or textile fibres and the rest is composed of phenolic resin binder.

7. A cowling according to claim 6 wherein about 75% by volume of said nonwoven layer is composed of synthetic and/or textile fibres.

8. A cowling according to Claim 1, wherein the free surface of the support layer is provided with a 0.5 to 2 mm thick covering layer of cotton fibres, polyester fibres or polyacrylonitrile fibres.

9. A self-supporting, heat and sound insulating cowling for internal-combustion engines of motor vehicles,

substantially as described herein with reference to and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9306047.3

Relevant Technical fields

(i) UK Cl (Edition L) B5N, F2X

(ii) Int Cl (Edition 5) B32B, B60R, F02B

Search Examiner
R J MIRAMS

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search
11 JUNE 1993

Documents considered relevant following a search in respect of claims 1 TO 9

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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US006145617A

United States Patent [19]

Alts

[11] Patent Number: 6,145,617

[45] Date of Patent: Nov. 14, 2000

[54] **ULTRA-LIGHT, MULTIFUNCTIONAL SOUND-INSULATING KIT**

[75] Inventor: **Thorsten Alts**, Bieberau, Germany

[73] Assignee: **Rieter Automotive AG**, Zollikon, Switzerland

[21] Appl. No.: **09/269,601**

[22] PCT Filed: **Oct. 29, 1997**

[86] PCT No.: **PCT/CH97/00412**

§ 371 Date: **Mar. 24, 1999**

§ 102(e) Date: **Mar. 24, 1999**

[87] PCT Pub. No.: **WO98/18657**

PCT Pub. Date: **May 7, 1998**

[30] **Foreign Application Priority Data**

Oct. 29, 1996 [AT] Austria 381/96

[51] **Int. Cl.**[7] **E04B 1/82**

[52] **U.S. Cl.** **181/290**; 286/294

[58] **Field of Search** 181/286, 290, 181/294, 296; 428/903; 442/346, 378, 398, 57

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,298,694 3/1994 Thompson et al. 181/286

5,493,081 2/1996 Manogold 181/286

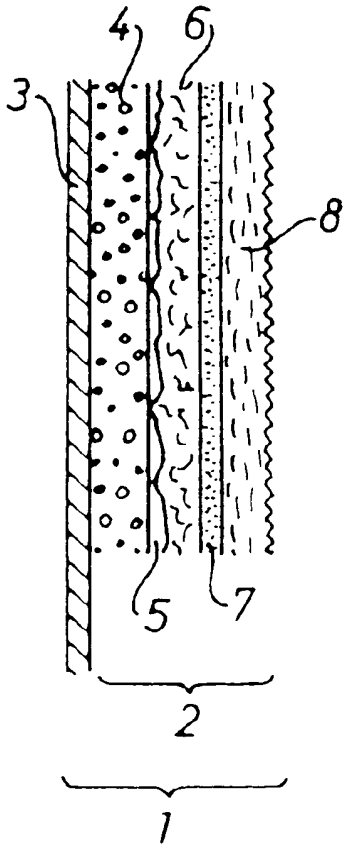
Primary Examiner—Khanh Dang

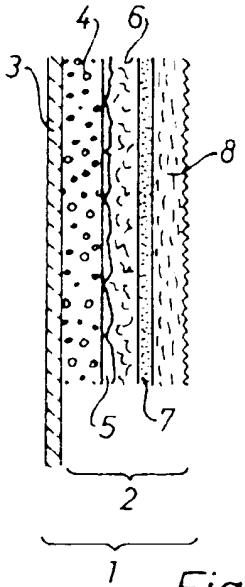
Attorney, Agent, or Firm—Nath & Associates

[57] **ABSTRACT**

A kit for reducing noise in motor vehicles having at least one areal vehicle part, the kit having a sound-insulating assembly package having several layers and an at least partly interlaying air layer. This assembly package has at least one porous cushioning layer, a microporous reinforcing layer which is lightweight, stiff and openly porous, an air flow resistance between R_1=500 Nsm^{-3} and R_1=2,500 Nsm^{-3}, and a surface area of mF=0.3 kg/m^2 to mF=2.0 kg/m^2. The reinforcing layer has a stiffness of B=0.05 Nm to B=10.5 Nm. This permits replacing the weight of classic spring-mass-systems for noise reduction in vehicles with a system at least 50% lighter. In addition to the dampening effect on oscillations, this kit absorbs sound and provides thermal insulation. Preferably, this multifunctional, ultralight kit is used to insulate the floor or firewall, or as a door lining or roof inner lining.

101 Claims, 7 Drawing Sheets

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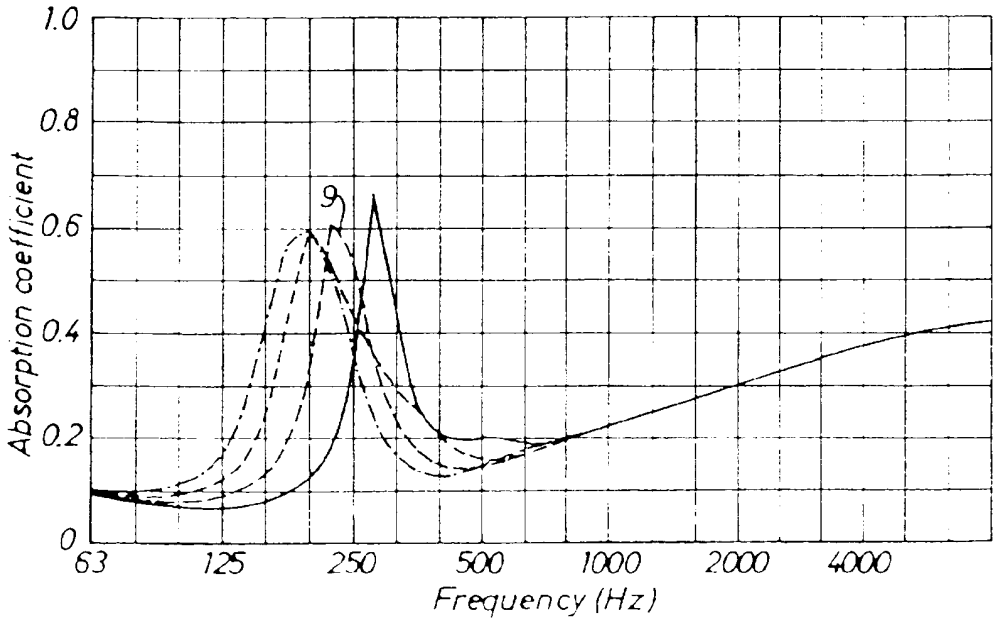
6
3
8
5
7
2
1

Fig. 1


1.0
0.8
0.6
0.4
0.2
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Absorption coefficient
9
63
125
250
500
1000
2000
4000
Frequency (Hz)

Fig. 2

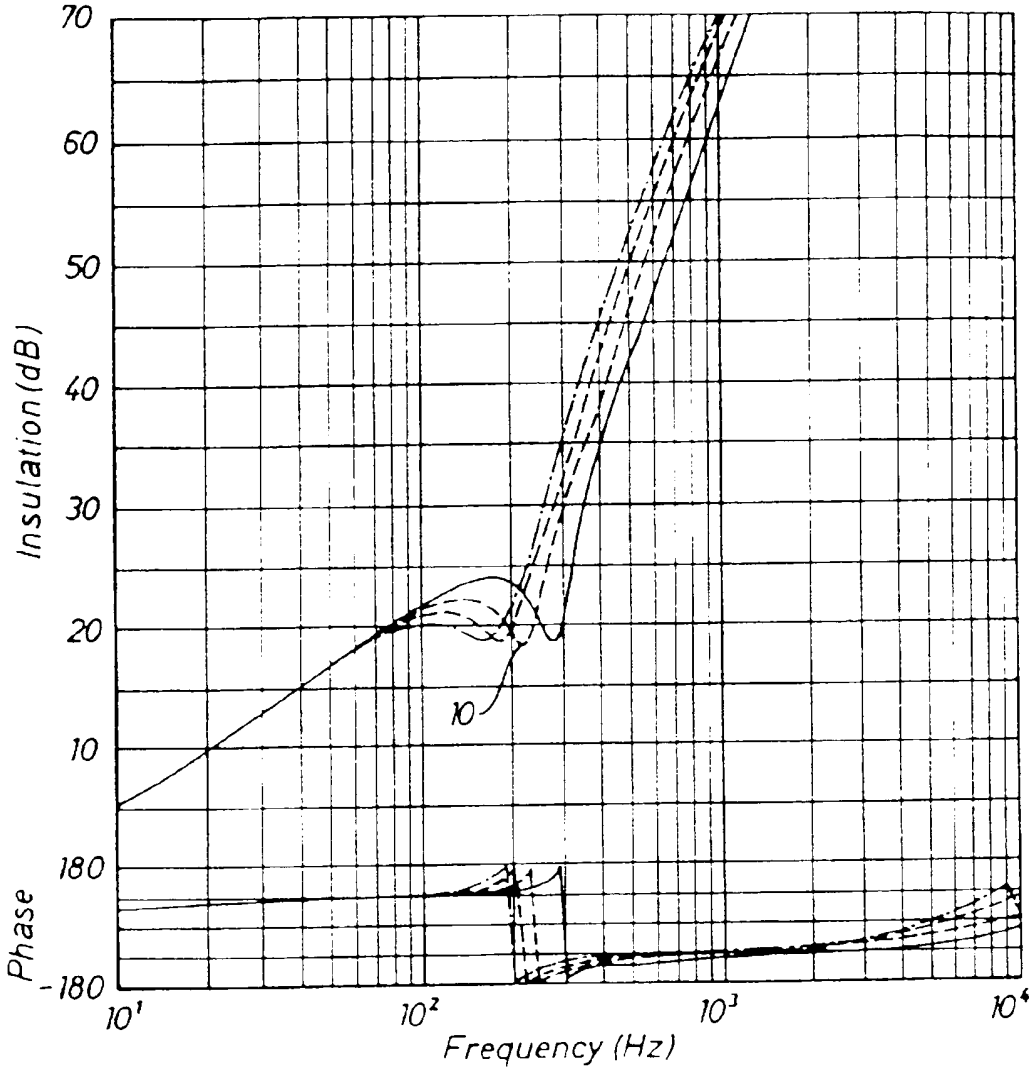
70
60
50
40
30
20
10
Insulation (dB)
10
180
-180
Phase
10^1
10^2
10^3
10^4
Frequency (Hz)

Fig. 3

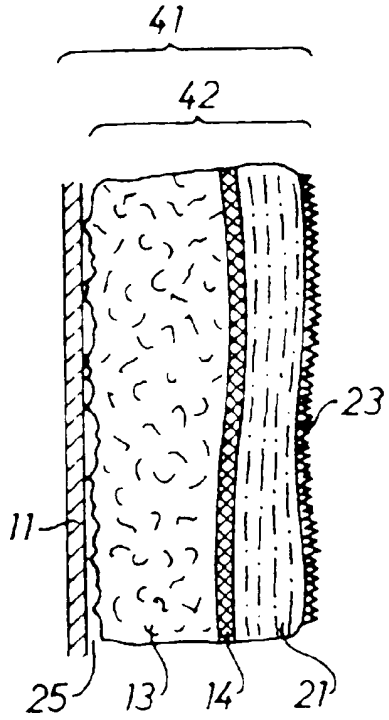

Fig. 4

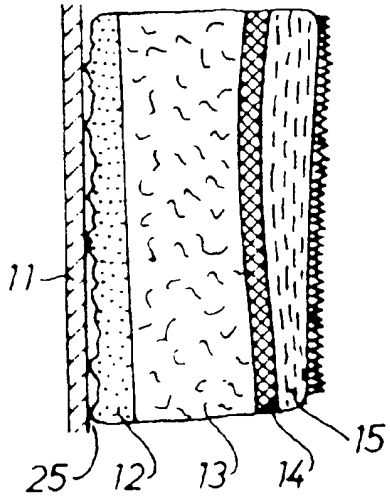

Fig. 5

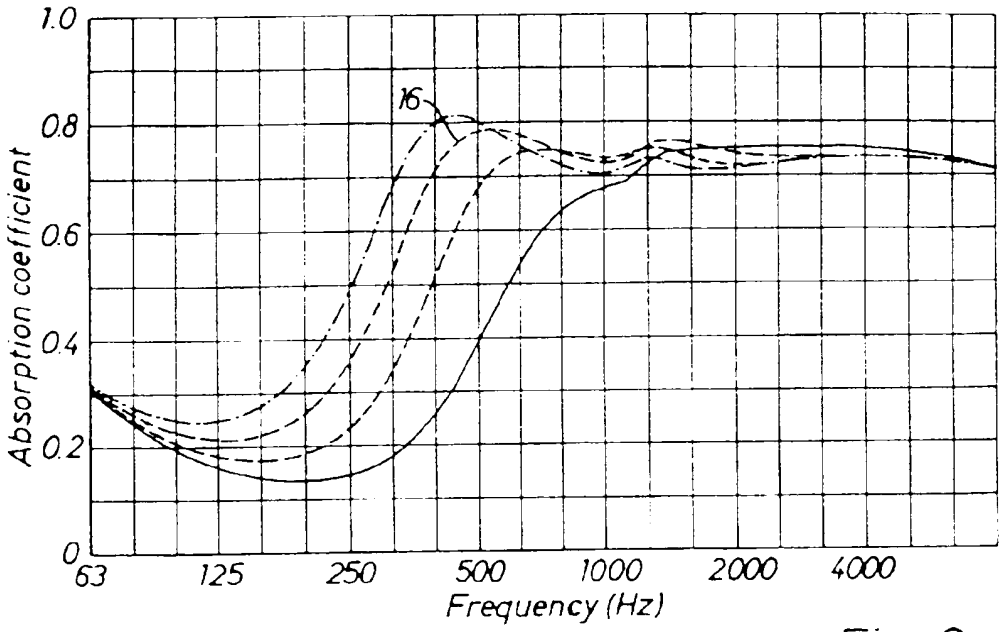
1.0
0.8
0.6
0.4
0.2
0
Absorption coefficient
16
63
125
250
500
1000
2000
4000
Frequency (Hz)

Fig. 6

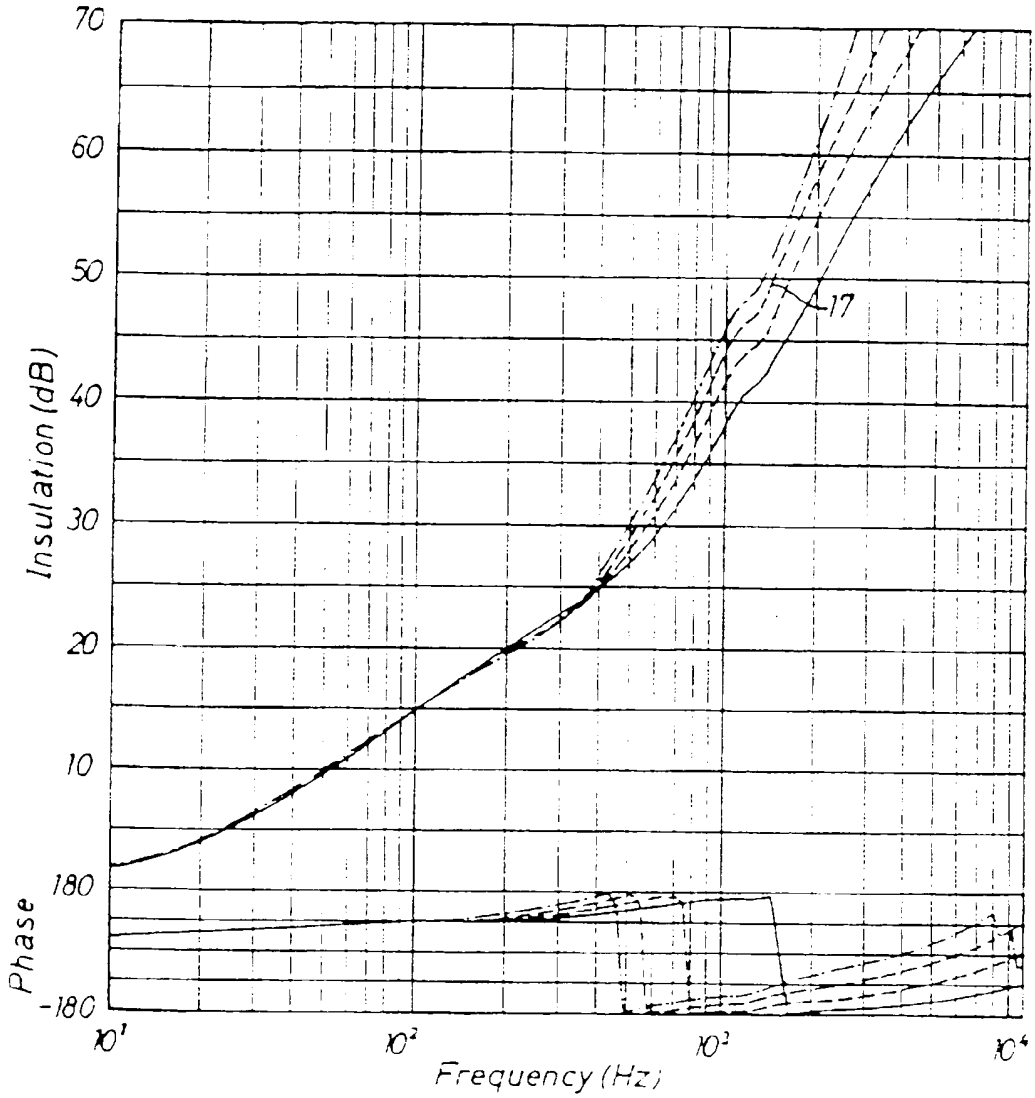
70
60
50
40
30
20
10
Insulation (dB)
17
180
Phase
-180
10^1
10^2
10^3
10^4
Frequency (Hz)

Fig. 7

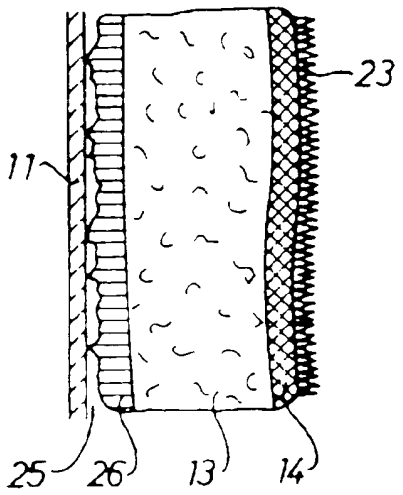

Fig. 8

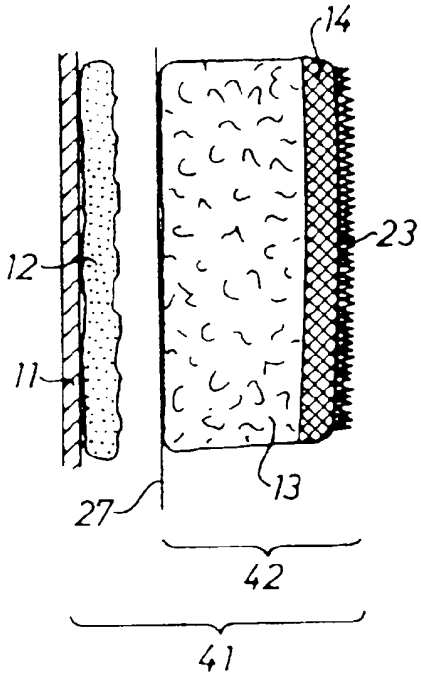

Fig. 9

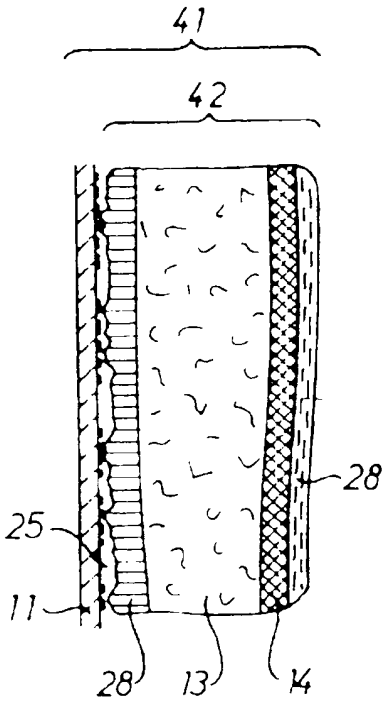

Fig. 10

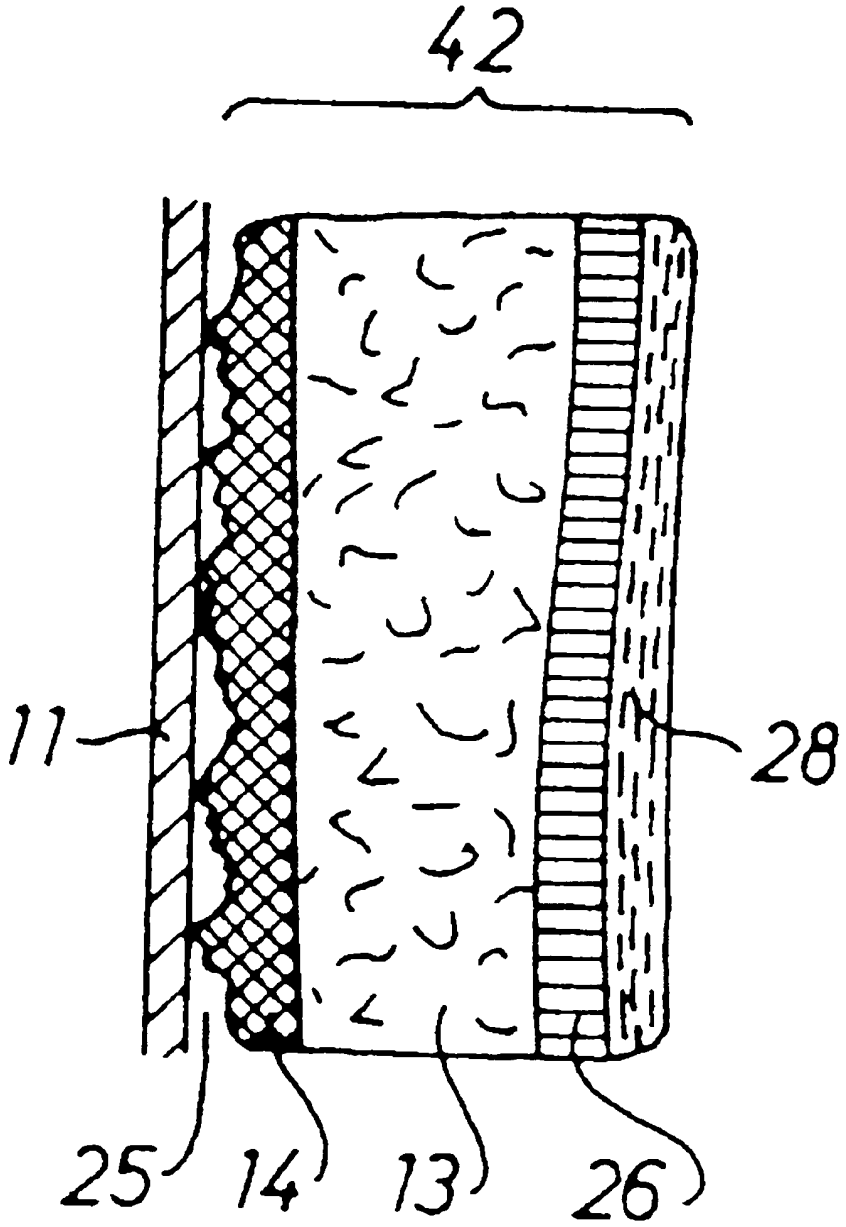

Fig. 11

ULTRA-LIGHT, MULTIFUNCTIONAL SOUND-INSULATING KIT

The present invention relates to a multifunctional kit for the noise reduction and heat insulation in vehicles, according to the preamble of claim 1.

Large areal vehicle parts, such as floor sheeting, roof sheeting, boot lids, end faces or doors and side coverings tend to deform, vibrate and oscillate on travelling on account of their low inherent stability. This behaviour is conventionally counteracted by mounting damping material, in particular of heavy layers of bitumen. In order to reduce the transmission of travelling noises in the inside of the vehicle, in the automobile industry, since a long time, additionally, multi-layered sound insulation assemblies have been applied. In particular by way of these sound insulation assemblies, noises from the vehicle motor, from the gearbox and auxiliary units, from exhaust systems but also wind and tire noises are effectively insulated. These sound insulating assemblies as a rule are conceived as spring-mass-systems and all comprise an airtight heavy layer coupled to an elastic spring layer in order to damp the vibrations of the large areal car body parts and to insulate the airborne noise.

Such a sound insulating package is for example described in EP-0'334'178 and comprises essentially a soft-elastic foam material layer which faces the car body part capable of oscillation and which acts as the spring of the spring-mass system, an almost compact, air-impermeable and consolidated layer of the same material, which acts as the mass of the spring-mass-system, wherein this for consolidation is incorporated into a frame of fleece or cut foam, as well as a decor covering or carpet layer arranged thereabove. By way of this construction the weight of the heavy layer may be reduced up to 40% and thus also the weight of the whole sound insulation system may be reduced with respect to the known spring-mass-systems, but however at the cost of the acoustic effectiveness.

In EP-0'255'332 a sound insulating package is disclosed which with the help of a semi-flexible carrier layer, in the manner of a snap closure, is tensioned against the vehicle roof. With this carrier layer a classic spring-mass-system of a resilient, sound-absorbing foam layer and of a visco-elastic, closed-pored heavy layer (filled with bitumen) is pressed against the vehicle roof. By way of the non-positive connection of the heavy layer to the vehicle roof the vibrations of this are damped better and the heavy layer no longer needs to cover the whole surface.

Generally spring-mass arrangements however lead to the onset of resonance in the sound insulation, which usually lie in the frequency range of the lower motor arrangements and here are particularly undesirable. This phenomenon as a rule forbids an extremely light construction.

It is the general desire of the automobile industry to reduce the weight of vehicles. This has the result that increasingly also thinner and lighter car body parts are applied, which leads to considerable acoustic disadvantages. The demands on the sound insulation assemblies are significantly increased by the use of lightweight car body parts.

It is therefore the object of the invention to provide an ultra-light kit which also with lightweight car body parts, for example of aluminium or plastic, has no loss of acoustic effectiveness.

In particular a sound-insulating kit is to be provided which is more than 50% lighter than conventional sound-insulating assemblies and furthermore has good heat-insulating properties.

According to the invention this object is generally achieved by a kit with the features of claim 1 and is

particularly achieved in that the air-impermeable heavy layer with conventional spring-mass systems is replaced by a relatively thin, micro-porous and stiff fibre layer, or fibre foam composite layer. This micro-porous fibre layer is open-pored and has a relatively high airflow resistance. Essential for the solution of the object set is the formation of an air layer in the sound-absorbing kit, the air layer preferably lying between the areal car body part and the other layers. As a result basically the weight of the insulating mechanism with conventional spring-mass-systems is reduced in favour of an improved sound absorption. The effectiveness of the kit according to the invention thus involves an optimal combination of sound insulation and absorption. The considerable increase of the absorption coefficients achieved according to the invention leads to the fact that this kit has an extremely light construction and also with lightweight car body parts have no reduction in the acoustic effectiveness. Furthermore with the kit according to the invention surprisingly it has been found that there is also a considerable improvement of the insulation in the region of the normally occuring onset of resonance.

In a first embodiment form the multi-functional kit according to the invention comprises essentially a soft-elastic, open-pored, spring layer facing the car body part capable of oscillation, this layer consisting of foam or fibre fleece, a microporous and light stiffening layer, in particular a stiffly pressed fibre layer or fibre/foam composite layer, as well as a porous cover layer or carpet or protective layer arranged thereover. All these layers may be connected to one another to a composite part mechanically (stitched), or by partial air-permeable adhesings. In a further formation of this embodiment form the kit according to the invention on the car body side comprises a light damping layer which is applied in a partial or complete-surfaced manner, which preferably has a surface pattern according to patent EP 0 474 593 and is applied onto the car body sheeting. In flat regions of the car body a light "constrained-layer" damping of ultra-light bitumen and of a tension resistant foil of aluminium or fibre-reinforced plastic paper may be applied. This is conventionally adhesed to the plating.

Further preferred embodiment forms are specified in the dependent claims of the present application.

By way of the acoustic optimisation of the soft-elastic, open-pored layer combined with the likewise open-pored, microporous fibre layer or fibre/foam composite layer arranged thereover, one obtains a) a sound insulation without the onset of resonance, b) a sound absorption on the decor or carpet side, which is already effective in the low frequency region, c) a heat insulation which is advantageous with vehicles with a very low fuel consumption and d) a considerable reduction in weight of more than 50% in comparison to the classic spring-mass construction with vehicles with a steel car body, and with a simultaneously improved acoustic overall effectiveness.

Subsequently the invention is explained in more detail by way of a few embodiment examples and with the help of figures. With this there are shown:

FIG. 1: a classic construction of a floor group;

FIG. 2: the course of the absorption coefficients as a function of the frequency for the floor group according to FIG. 1;

FIG. 3: the course of the insulation as a function of the frequency for the floor group according to FIG. 1;

FIG. 4: the principle construction of the kit according to the invention;

FIG. 5: a kit according to the invention for the floor insulation or inner end wall covering.

FIG. **6**: the course of the absorption coefficient as a function of the frequency for the kit according to FIG. **5**;

FIG. **7**: the course of the insulation as a function of the frequency for the kit according to FIG. **5**;

FIG. **8**: a construction through a roof inner covering according to the invention;

FIG. **9**: a construction through a dooor covering according to the invention;

FIG. **10**: a construction through an adhesed outer end wall according to the invention;

FIG. **11**: a construction through an applied outer end wall according to the invention;

The conventional floor group **1** shown in FIG. **1** comprises a sound insulating package **2** constructed of several layers, which is fastened on a flat, i.e. areal car body part **3**. With conventional vehicles this car body part is manufactured of an approximately 0.8 mm thick steel sheeting, which has an area-weight of approx. 6.32 kg m^2. On this car body part **3** there is mounted a damping layer **4**, as a rule an approx. 2.2 mm thick bitumen-layer, with approx. 3.5 kg/m^2 surface weight. With this damping layer **4** essentially high frequeny oscillations are damped. Onto this damping layer as a rule a spring-mass system is loosely applied so that between the damping layer **4** and the spring-mass system there arises an approx 0.2 mm thick air layer **5**. The spring-mass system comprises an approx. 15 mm thick fibre layer **6** with a spacial weight of approx. 70 kg/m^3 or an area-weight of appprox. 1.05 kg/m^2. Insead of this fibre layer **6** also similarly heavy elastic foam layers are used. Connected to this is an approx. 2 mm thick, air-impermeable heavy layer **7** with an area-weight of approx. 4.0 kg/m^2 on which in turn there is deposited for example an approx. 5.0 mm thick carpet **8** of approx. 0.6 kg/m^2 surface weight. This classic floor group thus comprises a total surface weight of approx. 15.47 kg/m^2 of which the area-weight of the sound insulation package **2** constitutes a part of approx. 9.15 kg/m^2.

The curve **9** represented in FIG. **2** shows the behaviour of the absorption coefficients as a function of the frequency of this floor group **1**. From this it can be clearly recognised that this sound insulation package in the region of 200 Hz comprises a marked resonance absorption, and in the region above 500 Hz shows a clearly worse absorption which with an increasing frequency improves slightly. This slightly increasing absorption is only caused by the properties of the carpet.

The frequency course **10** of the insulation, which is represented in FIG. **3** and belongs to this floor group **1** clearly illustrates the insulation of the high frequency sound, and shows an onset of insulation in the region of 200 Hz which is characteristic for all spring-mass systems.

With the use of approx. 1.1 mm thick aluminium sheeting instead of the approx. 0.8 mm thick steel sheeting as a car body part **3** with these conventional insulation systems the complete insulation is worsened by approx. 6 dB and the onset of resonance of the insulation and the resonance absorption are displaced to somewhat higher frequencies in the region about 250 Hz. This is as a result of the halving in mass with the use of aluminium instead of steel.

The principle construction of the kit **41** according to the invention shown in FIG. **4** comprises essentially an areal vehicle part **11** and an assembly package **42** bearing thereon. This assembly package **42** comprises several layers and by necessity a porous spring layer **13** and a microporous stiffening layer **14**. The porous spring layer **13** is preferably formed from an open-pored foam layer. The microporous stiffening layer consists preferably of an open-pored fibre layer or fibre foam composite layer which has a total airflow resistance of R_t=500 Nsm^{-3} to R_t=2500 Nsm^{-3}, in particular from R_t=900 Nsm^{-3} to R_t=2000 Nsm^{-3}, and an areal-mass of m_f=0.3 kg m^2 to m_f=2.0 kg m^2, in particular of m_f=0.5 kg m^2 to m_f=1.6 kg m^2. For helping, further layers **21** and **23** may be deposited. Essential to the acoustic effectiveness of the multifunctional kit **41** is an air layer **25** between the assembly package **42** and the areal vehicle part **11**. In order to further improve this acoustic effectiveness the microporous stiffening layer **14** has a bending stiffness of B=0.005 Nm to B=10.5 Nm, in particular from B=0.025 Nm to B=6.0 Nm.

The ultralight kit according to the invention, according to FIG. **5** is particularly suitable for the construction of a floor insulation or the inner end wall covering. It comprises an approx. 1.1 mm thick aluminium car body part **11**, on which there is applied a light damping layer **12**, for example an SDL damping layer, whilst forming an air layer **25**. Such SDL damping layers are known and as a rule have a surface pattern according to the patent EP 0 474 593 and a special bitumenous material composition. These are applied with the pattern onto the sheeting and are rigidly connected to the soft foam system. The effective density of this damping layer **12** is ρ=1100 kg/m^3. In the present embodiment example an approx. 2.0 mm thick damping layer with an area-weight of approx. 2.4 kg/m^2 is used. Onto this there is applied an approx. 25 mm thick layer of moulded foam **13** with a spacial weight of approx. 20 kg/m^3, or with an area-weight of approx. 0.4 kg/m^2 to 1.75 kg/m^2. This moulded foam layer **13** is in particular a thermomoulded foam layer and is open-pored and is connected to an approx. 1.5 mm to 5.0 mm thick microporous, stiff fibre layer **14** of approx. 0.6 kg/m^2 to 1.6 kg/m^2 surface weight. Suitable as a damping layer are also ultra-light, bitumenous damping layers of several layers, which for example comprise an aluminium foil or fibre-reinforced plastic paper or bitumen-free damping materials, for example EPDM or moulded foam with an effective spacial weight of approx. 40 kg/m^3. The microporous fibre layer **14** is of the type such that this has a total airflow resistance of R_t=500 Nsm^{-3} to R_t=2500 Nsm^{-3}, in particular from R_t=900 Nsm^{-3} to R_t=2000 Nsm^{-3}, and an areal-mass of m_f=0.3 kg/m^2 to m_f=2.0 kg/m^2, in particular of m_f=0.5 kg m^2 to m_f=1.6 kg m^2 and a bending stiffness of B=0.005 Nm to B=10.5 Nm, in particular of B=0.025 Nm to B=6.0 Nm. This microporosity and stiffness are essential for the absorption capability of the whole assembly package and may be achieved by way of a suitable choice of various materials. With the application as floor insulation a carpet or decor layer **15** is connected to this microporous, stiff fibre layer **15** on the side of the vehicle passenger space and in this embodiment example has a thickness of approx. 5 mm or an area-weight of approx. 0.6 kg m^2. The assembly package **42** according to the invention thus weighs only approx. 4.1 kg m^2 and permits the weight of the complete floor group to be reduced from approx. 15.47 kg m^2 to approx. 7.07 kg m^2. With the application of this kit **41** as an inner end wall, the decor layer or carpet layer may be done away with.

The frequency dependent course **16** of the absorption coefficients shown in FIG. **6** clearly illustrates the special frequency course for the kit **41** according to the invention with an approx. 1.1 mm thick aluminium sheeting: perfect sound absorption in the middle frequency range and constant, not too large an absorption of α=0.7 to α=0.8 in the high frequency range. This is necessary for maintaining the ability to understand conversation in the vehicle.

The course **17** of the frequency dependent insulation of the kit **41** according to the invention, which can be deduced

from FIG. **7** clearly no longer shows any onset of resonance, as occurs as a matter of course with the conventional spring-mass-systems in the region of 200 Hz.

A further application of the kit **41** according to the invention for the insulation of a roof inner covering (sky roof) is shown in FIG **8**. This comprises an approx. 2 mm thick carrier layer **26** of a highly pressed fibre material with an area-weight of approx. 0.5 kg/m^2. As a subsequent layer there is an approx. 15 mm thick foam layer **13** with a spacial weight of approx. 20 kg/m^3. This foam or moulded foam layer according to the invention carries a stiffening layer **14**, in particular a microporous fibre layer of approx. 1.5 mm thickness and approx. 0.4 kg/m^3 surface weight. A porous, in particular open-pored, soft decor layer **23** of approx. 2 mm thickness or approx. 0.21 kg/m^2 surface weight closes this sound absorbing and oscillation damping, self supporting sky roof design. This multifunctional kit according to the invention thus comprises a complete thickness of approx. 24.5 mm and a complete surface weight of approx. 1.56 kg/m^2 and acts in the same manner as the previously described embodiment example. Further embodiment forms for the construction of a roof inner covering according to the invention are defined in more detail in the dependent claims **21** to **24**.

It is to be understood that this roof inner covering may also be provided with a damping layer, in particular with an approx. 4 mm thick foam damping with a surface pattern according to EP 0 474 593 and with an area-weight of approx. 0.15 kg/m^2.

In an alternative embodiment form of this roof inner covering the carrier layer **26** may be left out and the assembly package **42**, whilst forming an air layer **25**, is directly adhesed to the areal vehicle part **11**. By way of this, although the oscillation damping of the aluminium roof is reduced and the sound insulation, in particular with rain or tunnel journeys, is somewhat reduced, however with this still a sufficiently effective kit according to the invention with a thickness of approx. 18.5 mm and an area-weight of approx. 0.91 kg/m^2 may be realised.

The kit **41** according to the invention may also be applied to door coverings and comprises in one embodiment form according to FIG. **9** an approx. 2.4 mm thick, multi-layered damping layer which consists of an ultra-light bitumenous damping material and at least on approx. 0.1 mm thin aluminium foil. Such multi-layered damping systems directly adhesed to the sheeting are known. They are however as a rule at least 4 kg/m^2 heavy. The applied system according to the invention has an area-weight of still only approx. 2.67 kg/m^2 with a better damping efficiency than conventional systems. Subsequently there follows an air gap **25** of a variable thickness. This may in particular be used in order to accommodate the mechanics of the window. The actual assembly package **42** is protected against damp and contamination by a 25 μm thin PU-foil **27** with an area-weight of approx. 0.03 kg/m^2. The porous spring layer **13** and the microporous stiffening layer **14** are formed according to the features of claims **26** to **29**. This layer sequence is closed on the passenger space side by an approx. 2 mm thick porous cover layer **23**, in particular an open-pored decor layer, with an area-weight of approx. 0.21 kg/m^2. Thus this assembly package comprises an area-weight of approx. 3.51 kg/m^2. It is to be understood that this assembly package **42** may only be mounted partially and preferably only in the areal regions of the door.

It is to be understood that this kit **41** may also be provided with a damping layer **12** between the areal vehicle part **11**, this consisting either of multi-layered, approx. 2.3 mm thick ultra-light damping material with an area-weight of approx. 2.67 kg/m^2 and with at least one, approx. 0.1 mm thin aluminium foil, or of a multi-layered, approx. 2.3 mm thick, ultra-light damping material with an area-weight of approx. 2.67 kg/m^2 and with at least one approx. 0.1 mm thin foil of fibre reinforced plastic paper. Thus the area-weight of the multi-layered damping layer is approx. 2.54 kg/m^2.

The kit **41** according to the invention may also be applied as the outer end wall covering, as is shown in FIGS. **10** and **11**. The assembly package used for this comprises on the side of the motor space a dirt-resistant protective layer **28**, in particular an oil and water resistant protective fleece. The microporous stiffening layer **14** is arranged between the spring layer **13** and this protective layer, wherein the stiffening layer consists of a highly pressed fibre material with a thickness of approx. 2.5 mm and an area-weight of approx. 1.0 kg/m^2, the open-pored spring layer of the assembly package **42** either consisting of an approx. 15 mm thick thermomoulded foam with an area-weight of approx. 0.3 kg/m^2, or of an approx. 15 mm thick PU moulded foam with an area-weight of approx. 0.6 kg/m^2 to 0.9 kg/m^2, or of an approx. 15 mm thick duroplastic mixed fibre fleece of heat resistant fibres and with an area-weight of approx. 0.7 kg/m^2 to 1.0 kg/m^2. The protective layer on the motor space side comprises a thickness of 0.2 to 0.4 mm and an area-weight of 0.1 to 0.3 kg/m^2. With this embodiment form the assembly package **42** is adhesed in a simple manner to the areal vehicle part **11** whilst forming an air layer **25**.

In one further embodiment form of this assembly package **42** used as an outer end wall covering, as is shown in FIG. **11**, the microporous stiffening layer **14** lies between the porous spring layer **13** and the air layer **25**. Again the open-pored spring layer of the assembly package may consist of a thermomoulded foam, of a PU moulded foam or of a duroplastic mixed fibre fleece, and on the motor space side is provided with a protective layer **28**. This assembly package **42** may be adhesed to the areal vehicle part **11** or only layed on. In order to lay on the assembly package in a stable manner, this comprises a carrier layer **26**. It is to be understood that with these embodiment forms between the assembly package **42** and the air layer **25** there may also be provided a foam damping, which comprises a thickness of 3 mm and an area-weight of approx. 0.12 kg/m^2.

The advantages of the kit according to the invention are particularly evident with the application of thin steel sheeting or light aluminium sheeting or organo-sheeting, as is favourably used today in the automobile industry. A further advantage of the kit according to the invention lies in the extremely low heat conductability of the applied porous spring layer, which leads to the fact that this kit apart from its good acoustic effectiveness also has a good heat insulation.

What is claimed is:

1. A multi-functional insulation for use in vehicles, which is sound-absorbing, sound-insulating, oscillation-damping and heat-insulating, for use as a floor insulation, an end wall insulation, a door covering, or a roof inner covering, in combination with at least one sheet-like vehicle part and having a noise-reducing assembly package of several layers, the assembly package comprising:

at least one porous resilient layer;

a microporous stiffening layer which has a total airflow resistance of R_t=500 Nsm^{-3} to R_t=2500 Nsm^{-3}, and an areal-mass of m_f=0.3 kg/m^2 to m_f=2.0 kg/m^2;

wherein between the assembly package and the sheet-like vehicle part there is provided an air layer; and

wherein said multi-layered assembly package is a heavy-layer free package.

2. The multi-functional insulation according to claim 1 wherein the microporous stiffening layer has a bending stiffness of B=0.005 Nm to B=10.5 Nm.

3. The multi-functional insulation according to claim 1 wherein the assembly package further comprises a porous cover layer selected from the group comprising a soft decor layer, a carpet layer, or a dirt-resistant protective fleece.

4. The multi-functional insulation according to claim 1 wherein the at least one porous resilient layer is disposed between the air layer and the microporous stiffening layer.

5. The multi-functional insulation according to claim 1 wherein the porous resilient layer comprises a thermomoulded foam with a density of $\rho \leqq 30$ kg/m^3.

6. The multi-functional insulation according to claim 1 wherein the porous resilient layer comprises a PU moulded foam with a density of $\rho \leqq 70$ kg/m^3.

7. The multi-functional insulation according to claim 1 wherein the porous resilient layer comprises a thermoplastic mixed fibre fleece with a density of $\rho \leqq 70$ kg/m^3.

8. The multi-functional insulation according to claim 1 wherein the porous resilient layer comprises a duroplastic fibre fleece with a density of $\rho \leqq 70$ kg/m^3.

9. The multi-functional insulation according to claim 5, further comprising a damping layer, at least a portion of which is disposed between the assembly package and the sheet-like vehicle part.

10. The multi-functional insulation according to claim 9, wherein the damping layer has a thickness of about 2.2 mm and comprises an ultra-light damping material with an area-weight of about 2.4 kg/m^2, wherein:

the damping layer is adhesed onto the sheet-like vehicle part;

the air layer, formed between the assembly package and the damping layer by a relief-like support of the assembly package has a thickness of about 0.2 mm.

11. The multi-functional insulation according to claim 9, wherein the damping layer comprises a multi-layered, ultra-light damping material comprising:

at least an about 0.2 mm thin aluminum foil and having an area-weight of about 2.94 kg/m^2; wherein

the damping layer is adhesed onto the sheet-like vehicle part;

the air layer, formed between the assembly package and the damping layer by a relief-like support of the assembly package, has a thickness of about 0.2 mm.

12. The multi-functional insulation according to claim 9, wherein the damping layer comprises a multi-layered, ultra-light damping material comprising:

at least an about 0.2 mm thin fibre-reinforced plastic paper and having an area-weight of about 2.67 kg m^2; wherein

the damping layer is adhesed onto the sheet-like vehicle part;

the air layer, formed between the assembly package and the damping layer by a relief-like support of the assembly package, has a thickness of about 0.2 mm.

13. The multi-functional insulation according to claim 9, wherein the damping layer has a thickness of about 2.0 mm and comprises an ultra-light EPDM damping material with an area-weight of about 2.4 kg m^2 and a relief like structured surface; wherein

the damping layer has a first side and a second side, said first side lies with the relief-like structured surface on the sheet-like vehicle part so that the air layer, formed between the relief-like structured surface of the damping layer and the sheet-like vehicle part, at least in regions, has a thickness of about 0.2 mm, and said second side is fastened to the porous resilient layer.

14. The multi-functional insulation according to claim 9, wherein the damping layer comprises an about 4 mm thin moulded foam layer with an effective spacial weight of about 40 kg m^3 or an area-weight of about 0.2 kg m^2 and having a relief-like structured surface; wherein

the damping layer has a first side and a second side, said first side lies with the relief-like structured surface on the sheet-like vehicle part so that the air layer, formed between the relief-like structured surface of the damping layer and the sheet-like vehicle part, at least in regions, has a thickness of about 0.2 mm, and said second side is fastened to the porous resilient layer.

15. The multi-functional insulation according to claim 5 wherein, when used for the floor insulation, the assembly package comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

16. The multi-functional insulation according to claim 5, wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg/m^2 to 1.0 kg/m^2.

17. The multi-functional insulation according to claim 1 wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, is adhesed to the sheet-like vehicle part; and

the porous resilient layer comprises a stiff thermomoulded foam layer with a compression modulus of more than 120,000 Pa, with a thickness of about 13 mm to 17 mm and with an area-weight of 0.2 kg/m^2 to 0.4 kg/m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg/m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

18. The multi-functional insulation according to claim 1 wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, is adhesed to the sheet-like vehicle part; and

the porous resilient layer comprises an open-pored soft PU moulded foam layer with a compression modulus of less than 60 kPa, with a thickness of about 20 mm and with an area-weight of 0.8 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

19. The multi-functional insulation according to claim 1 wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, is adhesed to the sheet-like vehicle part; and

the porous resilient layer comprises a thermoplastic mixed fibre fleece with a density of less than 35 kg m^3, with a thickness of about 20 mm and with an area-weight of 0.7 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

20. The multi-functional insulation according to claim **1** wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer is adhesed to the sheet-like vehicle part; and

the porous resilient layer comprises a duroplastic mixed fibre fleece with a density of less than 50 kg m^3, with a thickness of about 20 mm and with an area-weight of 1.0 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

21. The multi-functional insulation according to claim **1** wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, bears against the sheet-like vehicle part, the assembly package additionally comprising:

an open-pored, stiff carrier layer; and

the porous resilient layer comprises a stiff thermomoulded foam layer with a compression modulus of more than 120,000 Pa, with a thickness of about 13 mm to 17 mm and with an area-weight of 0.2 kg m^2 to 0.4 kg/m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg/m^2 to 0.6 kg/m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg/m^2.

22. The multi-functional insulation according to claim **1** wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, bears against the sheet-like vehicle part, and additionally comprising:

an open-pored, stiff carrier layer;

the porous resilient layer comprising an open-pored soft PU moulded foam layer with a compression modulus of less than 60 kPa, with a thickness of about 20 mm and an area-weight of about 0.8 kg/m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

23. The multi-functional insulation according to claim **1** wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, bears against the sheet-like vehicle part, and additionally comprising:

an open-pored, stiff carrier layer; and

the porous resilient layer comprises a thermoplastic mixed fibre fleece with a density of less than 35 kg m^3, with a thickness of about 20 mm and with an area-weight of about 0.7 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

24. The multi-functional insulation according to claim **1** wherein, when used for the roof inner covering, the assembly package comprises a relief-like structured surface which, while forming an air layer, bears against the sheet-like vehicle part, and additionally comprises:

an open-pored, stiff carrier layer; and

the porous resilient layer comprises a duroplastic mixed fibre fleece with a density of less than 50 kg m^3, with a thickness of about 20 mm and with an area-weight of about 1.0 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 2.0 mm and an area-weight of 0.4 kg m^2 to 0.6 kg m^2; and further comprising

a porous decor layer having a thickness of about 2 mm and an area-weight of about 0.21 kg m^2.

25. The multi-functional insulation according to claim **21** wherein, when used for the roof inner covering, between the assembly package and the sheet-like vehicle part, at least partially, there is disposed a damping layer which comprises a moulded foam with a thickness of about 4 mm and an area-weight of about 0.2 kg m^2.

26. The multi-functional insulation according to claim **1** wherein, when used for the door covering an about 25 μmm thin PU foil with about 0.003 kg/m^2 surface weight is provided between the air layer and the assembly package;

the porous resilient layer comprising an about 15 mm thick thermomoulded foam with an area-weight of about 0.3 kg/m^2.

27. The multi-functional insulation according to claim **1** wherein, when used for the door covering, an about 25 μm thin PU foil with about 0.003 kg/m^2 surface weight is provided between the air layer and the assembly package;

the porous resilient layer comprising an about 15 mm thick moulded foam layer with an area-weight of about 0.6 kg/m^2 to 0.9 kg/m^2.

28. The multi-functional insulation according to claim **1** wherein, when used for the door covering, an about 25 μm thin PU foil with about 0.003 kg/m^2 surface weight is provided between the air layer and the assembly package,

the porous resilient layer comprising an about 15 mm thick thermoplastic mixed fibre fleece with a density of less than about 35 kg m^3 and an area-weight of about 0.5 kg/m^2.

29. The multi-functional insulation according to claim **1** wherein, when used for the door covering, an about 25 μm thin PU foil with about 0.003 kg/m^2 surface weight is provided between the air layer and the assembly package;

the porous resilient layer comprising an about 15 mm thick duroplastic mixed fibre fleece with a density of less than about 50 kg/m^3 and an area-weight of about 0.75 kg m^2.

30. The multi-functional insulation according to claim **26**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg m^2 and with at least an about 0.1 mm thin aluminum foil.

31. The multi-functional insulation according to claim **26**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg m^2 and with at least an about 0.1 mm thin foil of fibre reinforced plastic paper, wherein the area-weight of the multi-layered damping layer is about 2.54 kg m^2.

32. The multi-functional insulation according to claim **1** wherein

the porous resilient layer further comprises a 15 mm thick thermomoulded foam with an area-weight of about 0.3 kg m^2.

33. The multi-functional insulation according to claim **1** wherein

the porous resilient layer further comprises an about 15 mm thick PU moulded foam with an area-weight of about 0.6 kg m^2 to 0.9 kg m^2.

34. The multi-functional insulation according to claim **1** wherein:

the porous resilient layer further comprises an about 15 mm thick duroplastic mixed fibre fleece of heat-resistant fibres and with an area-weight of about 0.7 kg m^2 to 1.0 kg m^2.

35. The multi-functional insulation according to claim **32** wherein a dirt-resistant protective fleece is provided between the air layer and the assembly package, said dirt-resistant protective fleece having an area-weight of 0.05 kg m^2 to 0.15 kg m^2.

36. The multi-functional insulation according to claim **1**, wherein the microporous stiffening layer is disposed between the porous resilient layer and the air layer.

37. The multi-functional insulation according to claim **36** wherein, when used for the end wall insulation of a motor space side;

the microporous stiffening layer comprises a highly pressed fibre material with a thickness of about 2.5 mm and an area-weight of about 1.0 kg/m^2;

the porous resilient layer comprises an about 15 mm thick thermomoulded foam with an area-weight of about 0.3 kg/m^2; and

further comprising a dirt-resistant protective layer on the motor space side with a thickness of 0.2 to 0.4 mm and an area-weight of 0.1 to 0.3 kg/m^2.

38. The multi-functional insulation according to claim **36** wherein, when used for the end wall insulation of a motor space side;

the microporous stiffening layer comprises a highly pressed fibre material with a thickness of about 2.5 mm and an area-weight of about 1.0 kg/m^2;

the porous resilient layer comprises an about 15 mm thick PU moulded foam with an area-weight of about 0.6 kg/m^2 to 0.9 kg m^2; and

further comprising a dirt-resistant protective layer on the motor space side with a thickness of 0.2 to 0.4 mm and an area-weight of 0.1 to 0.3 kg/m^2.

39. The multi-functional insulation according to claim **36** wherein, when used for the end wall insulation of a motor space side;

the microporous stiffening layer comprises a highly pressed fibre material with a thickness of about 2.5 mm and an area-weight of about 1.0 kg/m^2;

the porous resilient layer comprises an about 15 mm thick duroplastic mixed fibre fleece of heat-resistant fibres with an area-weight of about 0.7 kg m^2 to 1.0 kg m^2; and

further comprising a dirt-resistant protective layer on the motor space side with a thickness of 0.2 to 0.4 mm and an area-weight of 0.1 to 0.3 kg m^2.

40. The multi-functional insulation according to claim **32** wherein, between the air layer and the assembly package a foam damping layer having a thickness of 3.0 mm and an area-weight of about 0.12 kg m^2 is provided.

41. The multi-functional insulation according to claim **1** wherein the sheet-like vehicle part is an about 0.8 mm thick steel sheeting.

42. The multi-functional insulation according to claim **1** wherein the sheet-like vehicle part is an about 1.1 mm thick aluminum sheeting.

43. The multi-functional insulation according to claim **1** wherein the sheet-like vehicle part is an about 1.5 mm thick fibre-reinforced plastic part.

44. The multi-functional insulation according to claim **1** wherein the porous resilient layer has a heat conductability λ of less than 0.05 W mK.

45. A multi-layered assembly package for a multi-functional insulation for use in vehicles, which is sound-absorbing, sound-insulating, oscillation-damping and heat-insulating, said multi-layered assembly package having several layers, the assembly package comprising: a microporous stiffening layer which has a total airflow resistance of R_t=500 Nsm^{-3} to R_t=2500 Nsm^{-3}, and an areal-mass of m_f=0.3 kg m^2 to m_f=2.0 kg m^2, and wherein said multi-layered assembly package is a heavy-layer free package.

46. The multi-layered assembly package according to claim **45**, wherein the microporous stiffening layer has a bending stiffness of B=0.005 Nm to B=10.5 Nm.

47. The multi-layered assembly package according to claim **45**, wherein the assembly package further comprises a layer selected from the group comprising a damping layer and an adhesive layer.

48. The multi-functional insulation according to claim **10** wherein, when used for the floor insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg/m^2 to 1.0 kg/m^2.

49. The multi-functional insulation according to claim **10** wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

50. The multi-functional insulation according to claim **37**, wherein a foam damping having a thickness of 3.0 mm and an area-weight of about 0.12 kg/m^2 is provided between the air layer and the assembly package.

51. The multi-functional insulation according to claim **1** wherein the porous resilient layer comprises an open-pored foam layer.

52. The multi-functional insulation according to claim **1** wherein the microporous stiffening layer comprises a layer selected from the group comprising an open-pored fibre layer and a fibre/foam composite layer.

53. The multi-functional insulation according to claim **1** wherein the microporous stiffening layer has a total airflow resistance of R_t=900 Nsm^{-3} to R_t=2000 Nsm^{-3}, and an areal-mass of m_f=0.5 kg m^2 to m_f=1.6 kg m^2.

54. The multi-functional insulation according to claim **2** wherein the microporous stiffening layer has a bending stiffness of B=0.025 Nm to B=6.0 Nm.

55. The multi-functional insulation according to claim **5** wherein the thermomoulded foam has a density of $\rho \leqq 15$ kg m^3.

56. The multi-functional insulation according to claim **6** wherein the PU moulded foam has a density of $\rho \leqq 15$ kg m^3.

57. The multi-functional insulation according to claim **7** wherein the thermoplastic mixed fibre fleece has a density of $\rho \leqq 35$ kg m^3.

58. The multi-functional insulation according to claim **8** wherein the duroplastic fibre fleece has a density of $\rho \leqq 50$ kg m^3.

59. The multi-functional insulation according to claim **13** wherein the EPDM damping material is bitumen-free.

60. The multi-functional insulation according to claim **21** wherein the open-pored, stiff carrier layer is selected from the group comprising a highly pressed, microporous fibre material and a honeycomb-like constructed carrier material, of about 3 to 5 mm thickness and an area-weight of 0.4 to 0.6 kg m^2.

61. The multi-functional insulation according to claim **22** wherein the open-pored, stiff carrier layer is selected from

the group comprising a highly pressed, microporous fibre material and a honeycomb-like constructed carrier material, of about 3 to 5 mm thickness and an area-weight of 0.4 to 0.6 kg m^2.

62. The multi-functional insulation according to claim **23** wherein the open-pored, stiff carrier layer is selected from the group comprising a highly pressed, microporous fibre material and a honeycomb-like constructed carrier material, of about 3 to 5 mm thickness and an area-weight of 0.4 to 0.6 kg m^2.

63. The multi-functional insulation according to claim **24** wherein the open-pored, stiff carrier layer is selected from the group comprising a highly pressed, microporous fibre material and a honeycomb-like constructed carrier material, of about 3 to 5 mm thickness and an area-weight of 0.4 to 0.6 kg/m^2.

64. The multi-functional insulation according to claim **32** wherein the dirt-resistant protective layer further comprises an oil and water resistant protective fleece.

65. The multi-functional insulation according to claim **33** wherein the dirt-resistant protective layer further comprises an oil and water resistant protective fleece.

66. The multi-functional insulation according to claim **34** wherein the dirt-resistant protective layer further comprises an oil and water resistant protective fleece.

67. The multi-functional insulation according to claim **35** wherein the dirt-resistant protective fleece further comprises an oil and water resistant protective fleece.

68. The multi-functional insulation according to claim **37** wherein the dirt-resistant protective layer is a water and oil resistant fibre fleece.

69. The multi-functional insulation according to claim **38** wherein the dirt-resistant protective layer is a water and oil resistant fibre fleece.

70. The multi-functional insulation according to claim **39** wherein the dirt-resistant protective layer is a water and oil resistant fibre fleece.

71. The multi-functional insulation according to claim **43**, wherein the fibre-reinforced plastic part is preferably organo-sheeting.

72. The multi-functional insulation according to claim **44**, wherein the porous resilient layer has a heat conductability λ of preferably 0.04 W/mK.

73. The assembly package according to claim **47** wherein the assembly package further comprises a damping layer and an adhesive layer.

74. The multi-functional insulation according to claim **9** wherein:

the porous resilient layer has a thickness of about 25 mm and a surface weight of about 0.4 kg m^2 to 1.75 kg m^2; and

the microporous stiffening layer has a thickness of 1.5 mm to 5.0 mm and an area-weight of 0.6 kg m^2 to 1.6 kg m^2.

75. The multi-functional insulation according to claim **6**, wherein, when used for the floor insulation, the assembly package comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

76. The multi-functional insulation according to claim **6**, wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area weight of 0.4 kg m^2 to 1.0 kg m^2.

77. The multi-functional insulation according to claim **7**, wherein, when used for the floor insulation, the assembly package comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

78. The multi-functional insulation according to claim **7**, wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

79. The multi-functional insulation according to claim **8**, wherein, when used for the floor insulation, the assembly package comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

80. The multi-functional insulation according to claim **8**, wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

81. The multi-functional insulation according to claim **9**, wherein, when used for the floor insulation, the assembly package comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

82. The multi-functional insulation according to claim **9**, wherein, when used for the end wall insulation, the assembly package further comprises a decor layer of about 5 mm thickness and an area-weight of 0.4 kg m^2 to 1.0 kg m^2.

83. The multi-functional insulation according to claim **22** wherein, when used for the roof inner covering, between the assembly package and the sheet-like vehicle part, at least partially, there is disposed a damping layer which comprises a moulded foam with a thickness of about 4 mm and an area-weight of about 0.2 kg/m^2.

84. The multi-functional insulation according to claim **23** wherein, when used for the roof inner covering, between the assembly package and the sheet-like vehicle part, at least partially, there is disposed a damping layer which comprises a moulded foam with a thickness of about 4 mm and an area-weight of about 0.2 kg/m^2.

85. The multi-functional insulation according to claim **24** wherein, when used for the roof inner covering, between the assembly package and the sheet-like vehicle part, at least partially, there is disposed a damping layer which comprises a moulded foam with a thickness of about 4 mm and an area-weight of about 0.2 kg/m^2.

86. The multi-functional insulation according to claim **1** wherein

the microporous stiffening layer has a thickness of about 1 mm to 1.5 mm and an area-weight of about 0.5 kg m^2; and

further comprising an open-pored decor layer having an area-weight of about 0.21 kg/m^2 and a thickness of about 2 mm.

87. The multi-functional insulation according to claim **27**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg m^2 and with at least an about 0.1 mm thin aluminum foil.

88. The multi-functional insulation according to claim **27**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg m^2 and with at least an about 0.1 mm thin foil of fibre-reinforced plastic paper, wherein the area-weight of the multi-layered damping layer is about 2.54 kg m^2.

89. The multi-functional insulation according to claim **28**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg m^2 and with at least an about 0.1 mm thin aluminum foil.

90. The multi-functional insulation according to claim **28**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-

layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg/m^2 and with at least an about 0.1 mm thin foil of fibre-reinforced plastic paper, wherein the area-weight of the multi-layered damping layer is about 2.54 kg/m^2.

91. The multi-functional insulation according to claim **29**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg/m^2 and with at least an about 0.1 mm thin aluminum foil.

92. The multi-functional insulation according to claim **29**, wherein the sheet-like vehicle part, at least partially, is provided with a damping layer, which comprises a multi-layered, about 2.3 mm thick ultra-light damping material, with an area-weight of about 2.67 kg/m^2 and with at least an about 0.1 mm thin foil of fibre-reinforced plastic paper, wherein the area-weight of the multi-layered damping layer is about 2.54 kg/m^2.

93. The multi-functional insulation according to claim **1**, wherein when used for the end wall insulation of a motor space side further comprises:

a dirt-resistant protective layer;

the microporous stiffening layer being disposed between the porous resilient layer and the dirt-resistant protective layer and comprises a highly pressed fibre material with a thickness of about 2.5 mm and an area-weight of about 1.0 kg/m^2;

the dirt-resistant protective layer having a thickness of 0.2 to 0.4 mm and an area-weight of 0.1 to 0.3 kg/m^2.

94. The multi-functional insulation according to claim **33** wherein a dirt-resistant protective fleece is provided between the air layer and the assembly package, said dirt-resistant protective fleece having an area-weight of 0.05 kg/m^2 to 0.15 kg/m^2.

95. The multi-functional insulation according to claim **33** wherein, between the air layer and the assembly package a foam damping layer having a thickness of 3.0 mm and an area-weight of about 0.12 kg/m^2 is provided.

96. The multi-functional insulation according to claim **34** wherein a dirt-resistant protective fleece is provided between the air layer and the assembly package, said dirt-resistant protective fleece having an area-weight of 0.05 kg/m^2 to 0.15 kg/m^2.

97. The multi-functional insulation according to claim **34** wherein, between the air layer and the assembly package a foam damping layer having a thickness of 3.0 mm and an area-weight of about 0.12 kg/m^2 is provided.

98. The assembly package according to claim **46**, wherein the assembly package further comprises a layer selected from the group comprising a damping layer and an adhesive layer.

99. The assembly package according to claim **98** wherein the assembly package further comprises a damping layer and an adhesive layer.

100. The assembly package according to claim **45** wherein the microporous stiffening layer has a total airflow resistance of R_t=900 Nsm^{-3} to R_t=2000 Nsm^{-3}, and an areal-mass of m_A=0.5 kg/m^2 to m_A=1.6 kg/m^2.

101. The assembly package according to claim **46** wherein the microporous stiffening layer has a bending stiffness of B=0.025 Nm to B=6.0 Nm.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,145,617

DATED : November 14, 2000

INVENTOR(S) : Alts

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 3, line 3, change "comprising" to --consisting of --

Claim 3, line 4, change "or" to --and--

Claim 9, line, 1, change "5" to --1--

Claim 47, line 3, change "comprising" to --consisting of--

Claim 52, line 3, change " comprising" to --consisting of--

Claim 60, line 3, change " comprising" to --consisting of--

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,145,617

DATED : November 14, 2000

INVENTOR(S) : Alts

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 61, line 3, change "comprising" to --consisting of --

Claim 62, line 3, change "comprising" to --consisting of--

Claim 63, line 3, change " comprising" to --consisting of--

Claim 98, line 3, change " comprising" to --consisting of--

Signed and Sealed this

Twenty-ninth Day of May, 2001

Attest:

Nicholas P. Godici

NICHOLAS P. GODICI

Attesting Officer

Acting Director of the United States Patent and Trademark Office